Moving E-Waste Management into the 21st Century: Protecting Health and Wealth from the Dangers of Electronic Waste

Author: Ian C. McIntire

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Ian McIntire

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Advisor: Prof. Michael Cermak

Signature: _____

IS Thesis Coordinator: Prof. Hiroshi Nakazato

Signature: _____

Abstract

Electronic waste (e-waste) is being generated faster than ever, threatening the health of people at home and abroad. This paper advocates for improvements in e-waste management that increase environmental protection in innovative ways that also benefit workers. It reviews what is being done around the world in response to the problem and then introduces suggestions on how public and private actors can cooperate to achieve better results, particularly within the United States.

The paper begins by examining the successes and failures of extended producer responsibility (EPR) regulations in Europe, the United States, China, and Japan. It then goes on to advocate for a system combining EPR with a refundable deposit to encourage consumer-driven increases in return rates. If people could receive five to ten dollars for recycling their old cell phone or laptop, far fewer would end up in landfills. The paper culminates with an examination of how the idea of "green-collar jobs" can apply to e-waste management. It examines non-college training programs to prepare people to work in this industry and bring them out of poverty. Several reports have discussed the e-waste issue and its policy implications but this will be the first that brings in the labor aspect.

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Abbreviations Used

EPA: Environmental Protection Agency

EPR: Extended Producer Responsibility

GAO: Government Accountability Office

GCJ: Green-Collar Job

GDP: Gross Domestic Product

NGO: Non-Governmental Organization

OECD: Organization for Economic Cooperation and Development

PBB: Polybrominated Biphenyls

PBDE: Polybrominated Diphenyl Ether

PRO: Producer Responsibility Organization

PVC: Polyvinyl Chloride

PWB: Printed Wiring Board

QWERTY/EE: Quotes for Environmentally-Weighted Recyclability and Eco-Efficiency

RoHS: Restriction of Hazardous Substances

WEEE: Waste Electrical and Electronic Equipment

E-Waste: The Hidden Threat

Electronic waste or "e-waste" is one of the fastest growing waste streams in the developed world and contains many chemicals and elements hazardous to human and ecological health. The US is a leading consumer of electronics, such as personal computers, printers, and cellular phones, but few people question where the enormous waste stream ends up. This changed when seven years ago the Basel Action Network released the film *Exporting Harm*, a groundbreaking documentary that showed firsthand how developed nations were allowing their hazardous and obsolete electronics to be shipped overseas. The film exposed how few precautions were being taken with the "recycling" of the exported e-waste, jeopardizing the long-term economic, reproductive, and environmental health of those who handled it. As an increasing number of countries, such as China, India, and Nigeria, found their poor, rural areas to be dumping grounds for the toxic "effluent of the affluent," questions about the resulting ecological and labor injustices arose. *Exporting Harm*, and other reports like it, brought more public awareness and triggered a flood of new ideas on how to handle the problems associated with discarded electronics and their disposal.

This report endeavors to both chronicle the most effective emerging policies surrounding e-waste management and lay out a path for future ways the e-waste industry can be sustainable while simultaneously providing working class people with new avenues for employment. This will involve evaluating the policies that are coming from the European Union but also examining the new models for sustainable and

economically-feasible labor programs that are being advocated in the US. The "Green Collar Jobs" framework, sparked by advocates such as Van Jones and Majora Carter, seeks to move beyond simple job-creation programs to understanding how all industries need to provide economic resources but also meet demands of sustainability and human welfare, a triple-bottom-line idea. Several reports have discussed the e-waste issue and its policy implications but this will be the first that brings in the labor aspect. The following is a breakdown of each of the major sections of this report.

New technologies, policies, and practices are now being designed to address the mounting e-waste problem. The European Union led the way with "extended producer responsibility" laws (EPR) that require the electronics manufacturers of all member states to pay for the recycling costs of their equipment and banning many toxic substances from their production. The successes and shortfalls of Europe's system are discussed in the first section of this paper, "Making the Polluters Pay: Europe's E-Waste Laws and their Implementation." This program may have costs to "efficiency" in the short-term, but the money saved through reduced (or at least stable) healthcare costs, lower cleanup costs, and greater reuse of materials will accumulate into large savings in the long term. Although electronics manufacturers may see a slight decline in profits, recycling industries will create new jobs that will help offset the costs to society. The governments of Japan and China have followed suit and the United States is moving towards greater regulation of e-waste as well. In the second section, "EPR Goes Global: The Spread of E-Waste Regulation from Europe to the US, China, and Japan," the impact that EPR legislation has had as it spread to other countries is evaluated.

Despite promising improvements in the situation, governments must continue to innovate. EPR legislation has had remarkable successes, but has not gone far enough to completely solve the problems it intends to address. The chapter, "Thinking Outside the Bottle: Refundable Deposits for E-Waste Recycling," illustrates how a consumer-incentive system could be set up that magnifies the effects of EPR legislation and aligns with environmental protection. Refundable bottle bills have been a mainstay of beverage recycling in much of the US since the 1970s and the model could be adapted to old electronics. If people could receive five to ten dollars for recycling their old cell phone or laptop, far fewer of them would end up in landfills. A 21st century "bottle bill" for electronics will be a fitting complement to existing regulations. Market-based solutions have proved effective in ameliorating many environmental problems, from roadside litter to acid rain; introducing a system of refundable deposits for e-waste may be the key to ending the rising tide of hazardous waste. When combined with producer-responsibility legislation that requires manufacturers to pay the cost of recycling the items, people would have an incentive to return their old or broken items without paying a fee to recycle them. The system promises to increase recycling rates greatly without complicated and expensive regulations.

Last, but most important for many working-class people, is the creation of green-collar work programs that help low-skilled workers train for and attain jobs within the recycling sector. Proponents of the GCJ framework, such as Van Jones, Majora Carter, and other leaders of the environmental justice movement have projected this message strongly and clearly, giving hope to many environmentalists and many less-skilled

workers. Within the electronics recycling process, however, this is easier said than done. To make the e-waste processing industry viable and efficient, there needs to be more examination of who can benefit most from the new jobs and how to ensure dignified opportunities for workers. In the section, “E-Waste and the Green Collar Economy: Creating Jobs for People and the Environment” some existing models and potential new ones will be examined.

Currently there are labor systems that include prison workers who process the waste, a measure that has been controversial due to the hazards of processing e-waste and other ethical considerations. At the same time there is an emerging movement for jobs that help the environment, “green jobs,” that is led by Van Jones, Majora Carter, and their NGO Green for All. The Green Collar Jobs (GCJ) movement strives not just for general low-wage, or dead-end labor but to develop green industry for meaningful career-track jobs that can lift people out of poverty. Although there have been a number of studies and articles analyzing the technical aspects of e-waste, my goal in this final chapter is to examine the social dimension and explore the green collar jobs framework for the e-waste industry. A GCJ framework cannot solve the e-waste problem alone; but by disciussing both technical policy and the GCJ framework together new insights may be found to benefit the expanding e-waste industry.

Making the Polluters Pay: Europe's E-Waste Laws and their Implementation

Europe has been leading the way on controlling the growing stream of e-waste since the beginning of this decade, both in what is produced and what is recycled within its borders. In Europe, the EU Parliament and Council passed a producer responsibility bill that requires manufacturers to accept old electronics and dispose of them properly, commonly referred to as the Waste Electrical and Electronic Equipment (WEEE) Directive.[1] This directive is often the starting point for discussions of how best to tackle the e-waste problem, and serves as a model for state programs in the US and national programs in Japan, China, and elsewhere. Complementing this, they have passed another directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) that limits the inclusion of certain toxic substances from products sold in the European market. Together, the WEEE and RoHS directives have the potential to greatly increase recycling, while reducing the number of hazardous chemicals included in new electronic equipment. There is a long way to go to fully address the problem, including overcoming barriers to implementation, working to encourage manufacturers to take a proactive role in the process, and refining the directives, but they set the stage for comprehensive legislation around the world.

The directives are based on the "polluter-pays principle," making them the first

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[1] European Parliament and Council, *Directive 2002/96/EC on waste electrical and electronic equipment (WEEE),* Joint declaration of the European Parliament, the Council and the Commission.

major step in the process of requiring manufacturers to internalize the costs associated with the production of new goods. Often, environmental and other costs of producing a good are not paid by the producer; according to Robert C. Hinkley,

> "The reason corporations are prone to violate the public interest is that corporate law dedicates the corporation solely to the pursuit of its own interest -- making money. Nothing in corporate law balances this dedication with respect for the public interest…Corporations are institutions, not people. They have no conscience, morals or sense of right and wrong. They have no sense of living in a community. They have none of the human traits and characteristics that restrain us in ways that laws cannot and that make living in a community possible."[2]

As a result, it is in the best interest of a corporation to find ways to externalize as many costs as possible, including environmental costs. Unfortunately for the average citizens, these externalized costs often must be paid in the form of municipal waste collection, hazardous waste or groundwater cleanups, and other remedial actions. This creates an unfair situation in which the group who benefitted from an action, the corporation and its shareholders, does not bear the full burden it imposes on the community. The polluter-pays principle is fairly self-explanatory: it asks polluters to pay the full cost of their actions. It thereby attempts to avoid what Garrett Hardin called "the tragedy of the commons," a situation in which individuals, or in this case corporations, receive a benefit from overusing or overtaxing a commonly held good, and that benefit does a harm spread throughout society.[3] In e-waste, cost externalization became a rapidly-increasing problem throughout the 1990s as the production of disposable electronic goods grew to keep up

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[2] Robert C. Hinkley, "Profits vs. Public Interest," *Miami Herald*, 11 June 2002, http://www.commondreams.org/views02/0611-01.htm, accessed 9 March 2009.
[3] Garrett Hardin, "The Tragedy of the Commons," *Science*, 162 (1968), 1243-1248.

with the tech boom. A 2007 study found that e-waste grew between "18-28 percent every five years," and with the large environmental costs associated with production and disposal, this represents a significant toll on the natural environment.[4]

The Directives

The WEEE directive states that "Producers should…finance collection from collection facilities, and the treatment, recovery and disposal of WEEE," in order to "contribute to high collection rates."[5] By reducing the burden on consumers and placing it on entities that are more easily regulated, the government intends to increase collection rates, decrease stress on non-renewable resources, and avoid the damage that comes with improper disposal. There are five factors that researchers have identified to measure the overall scope and effectiveness of e-waste regulations, "namely the elaboration of the legal regulation, system coverage, system financing, producer's responsibility, and compliance ensuring."[6] Europe's WEEE directive puts the financial burden entirely on the producer, sets ambitious returns targets, and covers a wide variety of goods,

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[4] I. Dalrymple, N. Wright, R. Kellner, N. Bains, K. Geraghty, M. Goosey, and L. Lightfoot, "An integrated approach to electronic waste (WEEE) recycling," *Circuit World*, Vol. 33, No. 2, 2007, Emerald Group Publishing, http://www.emeraldinsight.com/Insight/ViewContentServlet?contentType=Article&Filename=Published/EmeraldFullTextArticle/Articles/2170330207.html, accessed 9 March 2009.

[5] European Parliament and Council, Directive 2002/96/EC on waste electrical and electronic equipment (WEEE).

[6] Thomas Lindquist, *Extended Producer Responsibility in Cleaner Production*, The International Institute for Industrial Environmental Economics, Lund University, Sweden, 2000, cited by Xianbing Liu, and Masara Tanaka, Yasuhiro Matsui, "Electrical and electronic waste management in China: progress and the barriers to overcome," Waste Management & Research, Vol. 24, No. 1, 92-101 (2006), http://wmr.sagepub.com/cgi/content/abstract/24/1/92, accessed 27 March 2009.

contributing to its reputation as a role model of effective regulation. There are still some disputes over how the financial aspects of the regulation can be improved, however, in order to improve the incentives for "eco-design," harmonize the system across Europe, and ensure the collection of "orphaned" products (those produced by a manufacturer no longer in business). Despite the success of the WEEE directive, increasing the recycling targets for electronic products cannot end the problem of e-waste alone.

To combat the growing costs of recycling, and avoid further environmental degradation caused by electronics production and items that are not recycled, lawmakers included the RoHS directive. The directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment is based on "the precautionary principle." It states, "Member States shall ensure that, from 1 July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE)."[7] They give a significant list of exceptions, but it sets a precedent that certain substances can and will eventually be phased out of production processes based on their impact on human health.[8] Without comprehensive legislation like the RoHS directive, the use of these substances would likely continue

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[7] European Parliament and Council, "Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment," Official Journal L 037 , 13/02/2003 P. 0019 – 0023, available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri= CELEX:32002L0095:EN:HTML, accessed 27 October 2008.

[8] They particularly focus their efforts on sharply reducing the use of chemicals that may not be necessary or for which healthier alternatives exist. This requirement goes beyond reliance on recycling processes, stating, "Even if WEEE were collected separately and submitted to recycling processes, its content of mercury, cadmium, lead, chromium VI, PBB and PBDE would be likely to pose risks to health or the environment." These, and many other chemicals, can produce hazards even when recycled; some chemicals even make recycling difficult or impossible.

unabated, due to their ubiquity, the cost of changing industrial processes, and the higher cost of less environmentally-damaging materials. According to a 2005 scientific review of replacement options for some of the most widely-used environmental hazards, changes would always, or nearly always, be accompanied by cost increases.[9] Comprehensive legislation like the RoHS directive mitigates the impact of these cost increases by requiring that all manufacturers remove the hazardous substances, eliminating the argument that better environmental stewardship would put the companies at a competitive disadvantage.

Impact, Implementation, and Obstacles

Much of the importance of these directives derives not only from the impact on products made in Europe, but also by making it more profitable for many companies to follow similar practices in other regions. As Joel Boon describes, "Just as the least common denominator principle can cause companies to conform to the strictest law among U.S. states, thereby allowing one state's standards to become the de facto national standard, so too can the laws of one international body, the European Union, cause global companies and foreign governments to conform to their standards."[10] This can happen in

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[9]John D. Lincoln, Oladele A. Ogunseitan, Jean-Daniel M. Saphores, Julie M. Schoenung, Hilary Nixon, Andrew A. Shapiro, "Environmentally Benign Materials for Electronics: A Review of Current Developments and Emerging Technologies," IEEE 2005, http://ieeexplore.ieee.org/ielx5/9795/30881/01432064.pdf?arnumber=1432064, accessed 13 March 2009.

[10] Joel Boon, "Stemming the tide of patchwork policies: the case of e-waste," *Transnational Law and Contemporary Problems* 15, no. 2 (Spring 2006), 754.

a variety of ways, one of the most obvious being, as Boon points out, that states wishing to become members of the EU can enhance their chances by enacting a similar set of regulations. It also provides a framework for governments outside of Europe, making it much simpler to draft legislation and giving NGOs a precedent to cite as they lobby for better environmental protection.

In Europe, companies have found it easier to set up producer responsibility organizations (PROs) to handle the day-to-day financing of the recycling program on the manufacturers' behalf, organize collection and contract with recyclers to ensure their clients are in compliance with the law. This makes recycling simpler and more cost effective, at least in the short term, but many researchers assert that if implemented incorrectly, collective PROs can undermine the long term effectiveness of EPR legislation by removing incentives for producers to design their products to last longer and be easier to disassemble and recycle. [11] Kieren Mayers, the former environmental programs manager at Sony Computer Entertainment Europe (SCEE) supports this conclusion in his analysis of Sony's policies with regards to WEEE recycling. He states that SCEE has not found "any reduced end-of-life costs associated with" features designed to "improve recyclability and reduce the need for treatment at end of life."[12] Because manufacturers share the costs with other producers of similar products, they

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[11] Chris van Rossem, Naoko Tojo, and Thomas Lindquist, "Lost in Transposition? A Study of the Implementation of Individual Producer Responsibility in the WEEE Directive," The International Institute for Industrial Environmental Economics, Sept. 2006, http://www.greenpeace.org/raw/content/international/press/reports/lost-in-transposition.pdf, accessed 13 March 2009.

[12] Mayers, C. Kieren, "Strategic, Finanacial, and Design Implications of Extended Producer Responsibility in Europe; A Producer Case Study," *Journal of Industrial Ecology,* 127.

have only a marginal financial incentive to reduce the costs of recycling their own products. Legislation that requires end-of-life costs to be divided by producer, however, these pitfalls can be avoided.

New legislation can ensure that the potential benefits of EPR legislation become reality if implemented correctly. If we continue to have producers pay a portion of the overall cost of recycling relative only to their market share, then they will not see any change from improving their own products.[13] Rossem, Tojo, and Lindquist point out that products do not have to be collected separately for individual companies to bear the costs associated with their own products. Companies that collect or recycle the products can sort them by brand name and then charge each producer for its share of the recycling costs, keeping the process fairly simple while creating incentives for "eco-design." They also believe that such a system would ensure a level playing field that encourages competition that will lead to outcomes that benefit the environment and the producer simultaneously.[14] Some manufacturers have come out in favor of individual EPR as well. On the recycling page on Electrolux's website, they state, "Electrolux is an early advocate of producer responsibility. We were among the first in our industry to identify the business case for recycling and lobby actively for individual responsibility."[15] This should come as no surprise; manufacturers with business models that already incorporate

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[13] Ibid., 126.
[14] Chris van Rossem, Naoko Tojo, and Thomas Lindquist, "Extended Producer Responsibility: An Examination of Its Impact on Innovation and Greening Products," The International Institute for Industrial Environmental Economics, September 2006, http://www.greenpeace.org/international/press/reports/epr, accessed 13 March 2009, 7.
[15] "Recycling," Electrolux Corporate Information, http://www.electrolux.com/node195.aspx, accessed 13 March 2009.

eco-design or that may have an advantage in the development of more eco-friendly products will have an incentive to push for a well-designed EPR scheme that includes individual responsibility in order to gain competitive advantage. Designing legislation that provides adequately for individualized responsibility for end-of-life costs has not been the only problem encountered in Europe's transition toward better EPR.

In the European Union, member states have the responsibility to translate the directives of the European Parliament and Council into national law and to enforce those laws. In the case of WEEE, as in others, differences in the transposition of e-waste laws into national statutes has been uneven and in some cases even antagonistic to the stated intent of the directives. Van Rossem, Tojo, and Lindquist found that "nearly all [member states]" have created differing fee systems for producers opting to deal with their products individually rather than part of a "collective scheme" which "directly penalises individual producer responsibility and thus sets up an economic barrier to this important driver for future ecodesign." There are also differences among how collection will be run and financed in member states, leading to a regulatory environment that favors some manufacturers and/or countries over others.[16] Jaco Huisman et al echo this sentiment, even going so far as to say, "The net result is a complete chaos with having 25 completely different transpositions plus on top of that often inaccessible rules and agreement due to language problems."[17] Some of this problem results from honest

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[16] Chris van Rossem, Naoko Tojo, and Thomas Lindquist, "Lost in Transposition?" ix.
[17] Jaco Huisman, Ab Stevels, Thomas Marinelli, Federico Magalini, "Where did WEEE go wrong in Europe? Practical and academic lessons for the US," Proceedings of the 2006 IEEE International

mistakes that happened solely because of language barriers, but it also seems that different actors have different levels of commitment to the directives' mission. Some actors try to mitigate costs by allowing different transpositions or interpretations of the original documents, severely undercutting the goals of the legislation at the same time.

Another important shortcoming of WEEE legislation is that it sets targets for recycling by weight which, unfortunately, ignores the different environmental impacts associated with the production and disposal of different materials. Huisman et al advocate a system that targets the "environmental weight" of the products being recycled. The "quotes for environmentally-weighted recyclability and eco-efficiency," or QWERTY/EE, concept would put much less emphasis on the recycling of plastics in favor of recovering small amounts of precious metals and other components that have a much greater environmental impact during production and disposal.[18] This process would also take into account the type of recycling that occurs by its reduction of environmental impact. Some options for "recycling" merely involve shredding the material in question and using it as filler in various industrial processes, contributing a negligible amount to a real improvement in environmental stewardship.[19]

Symposium on Electronics and the Environment, 2006, http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1650039, accessed 13 March 2009, 84.

[18] Ibid, 83.

[19] Ibid., 86.

Benefits of the Program

Despite the shortcomings of EPR legislation, there are many reasons to be optimistic about the present direction of electronics recycling in Europe. Government agencies are increasingly aware of these problems, as evidenced by a working paper issued by the Commission of the European Communities, which reflects an awareness of problems related to collection and the need for legislation to account for the environmental weight of the different types of WEEE.[20] They plan to recommend modifications to the existing WEEE legislation, but are still divided over whether raising collection targets generally or setting them at 100% for particularly hazardous substances will be the most cost effective way to effect that change.[21] Either modification will represent a marked improvement in the effectiveness of e-waste legislation, particularly when accompanied by other simplifications and harmonization of the rules that will make compliance simpler and increase collection of WEEE from businesses.

Environmental consulting firms, product designers, and laboratories that develop and patent new materials are well positioned to take advantage of the new economic opportunities created by these directives, but the Commission's report suggests that the majority of new jobs created by this legislation are manual labor-intensive, giving them a

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[20] Commission of the European Communities, "Commission Staff Working Paper Accompanying the Proposal for a Directive of the European Parliament and Council on waste electrical and electronic equipment (WEEE): Impact Assessment," Brussels, http://ec.europa.eu/environment/waste/weee/pdf/sec_2008_2933_ia.pdf, accessed 14 March 2009, 30.
[21] Ibid., 73.

high social value for low-income people.[22] Over time, the benefits to society as a whole are also accumulating as the reductions in wasteful packaging and non-recyclable materials lead to less demand for new landfills and less hazardous materials in those landfills as a result of the WEEE directive. Communities located near existing landfills will have less to worry about as PVC, hexavalent chromium, and other hazards are eliminated from production processes as a result of the RoHS directive. This also has a significant social benefit because of the fact that landfills and incinerators are often located in low-income areas. Encouraging small, community-based programs for education about the benefits of WEEE collection has the potential to help people feel more of a sense of ownership of the problem and be more likely to change the way they handle their used electronics, improving the effectiveness of the programs.

In terms of its global environmental impact, the European directive banning certain toxic materials has the most potential, in the long run, to improve the environmental impact of electronic products. Products designed for the European market that do not contain the hazardous materials listed in the RoHS Directive can be released everywhere, rather than creating a hazardous version of each product to be released outside of Europe. As the most important manufacturing and retail centers of WEEE production implement, analyze, and improve this system, less toxics will be released during the production of new equipment. To be effective, the laws will have to be continually monitored and new substances will have to be regulated. This will not be

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[22] Ibid., 6.

easy, but independent monitoring and reporting will make the process much more effective by reporting to the governments on ways they can improve their programs.

Additionally, other countries outside Europe are beginning to follow their example, including China, Japan, and some parts of the US.[23] Each of them has implemented the system in subtly different ways that affect how and where items are collected, who pays for them, and how many people participate. Japan has seen the most success outside of Europe, but China and the US are making improvements that may move them ahead of Japan. One thing they all share is that they have finally recognized the threat and are working to minimize its effects.

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[23] "EU vs. China RoHS," http://www.rohscompliancedefinition.com/, accessed 20 February 2009 and RSJ Technical Consulting, "What is Japan 'RoHS'?" 2006, http://www.rsjtechnical.com/NewsRoHStransposition.htm, accessed 20 February 2009.

EPR Goes Global: The Spread of E-Waste Regulation from Europe to the US, China, and Japan

Europe's EPR legislation was a groundbreaking development, showing that government encouragement of better recycling practices has benefits for the environment and people without destroying the economy. It has led to the creation of similar initiatives in China, Japan, the United States, and even the developing world. It has served both as an example of successful planning and a warning of the potential pitfalls of such an ambitious plan. In the United States, many states have begun to pass producer-responsibility laws, increasing the likelihood of federal regulation in the foreseeable future. These laws most often follow the format of the WEEE directive, leaving RoHS out altogether. In China, both WEEE and RoHS have been emulated, but lax enforcement and worries over how the laws will affect their competitive advantage have limited the impact of the laws. The government has initiated two pilot programs that promise to yield more information that will allow the government to expand its efforts and rationalize the process. In Japan, companies must create recycling programs for certain products, but consumers are charged directly for the cost of recycling, reducing the incentives for eco-design. Since 2006, they have required all covered goods, whether domestic or imported, to be labeled if they contain any of the six substances covered by European RoHS. Overall, it is clear that Europe's example is pushing the idea of producer responsibility and greener electronics into the mainstream. Each country, however, has its own way of deciding how to best handle the problem and they are all experimenting with different

ways to achieve the goal most efficiently.

Regulation in the United States

The spread of EPR regulation in the US is proceeding incrementally. As with many environmental regulations in the US, EPR began as a number of state bills. They were passed first in a number of vanguard states and then adopted by a widening group as they proved effective and politically salient. The federal nature of American politics allows the most ambitious states to create working models for others to follow. This pattern has produced good results in certain states, but as a result, environmental protection is very uneven across the country.[1] Ideally, this process will lead manufacturers and retailers to demand a uniform policy. They will seek federal legislation that will allow them to harmonize among the various parts of their operations and create a level playing field where they can compete by one particular set of rules with other businesses throughout the country. E-waste regulations in the US are still in the first phase, with seventeen states and New York City currently requiring producers to pay the end-of-life costs of their products and ten more expected to pass them in 2009.[2]

In most of the states, the plan follows an outline similar to that of the WEEE

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[1] Rabe, Barry G., "Power to the States: The Promise and Pitfalls of Decentralization," in *Environmental Policy: New Directions for the Twenty-First Century*, ed. Norman J. Vig and Michael E. Kraft (Washington, D.C.: CQ Press, 2006, 34-56.

[2] Electronics TakeBack Coalition, "State Legislation on E-Waste," Tools for Legislators and Advocates, http://www.e-takeback.org/docs%20open/Toolkit_Legislators/state%20legislation/state_leg_main.htm, accessed 6 February 2009.

directive in Europe. As one of the earliest examples of state legislation, the Maine bill prohibits manufacturers from selling electronics without paying the fees associated with recycling it. Each manufacturer must submit a detailed compliance plan and can be fined up to three times the recycling cost if it fails to pay the costs on time.[3] California, the first to pass a bill regulating e-waste, has not yet passed a producer-responsibility law, but instead mandated a consumer fee to cover the cost of recycling. Their bill also included its own version of RoHS, which bans the same substances in electronics manufacturing as Europe and leading some to speculate that this could be a turning point in the production of electronics.[4] Drew Wilson, writing for *Green Supply Line*, argues that if manufacturers choose to seize this opportunity and begin to look at how whole supply chains work, they will start to see many benefits to what he calls "ecodesign."

Wilson uses Philips Consumer Electronics' business model as an example; in an interview, Ab Stevels, an adviser for environmental affairs for the company said, "'Both consumers and senior managers think green products are more expensive…It took [Philips] years to convince them that the prejudice is false.'"[5] Philips is not the only company making the change. Wilson also discusses the contributions of Envirowise, an environmental consulting firm that has done studies showing the potential for an industry

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[3] *Maine Revised Statutes, Title 38, Chapter 16:Sale of Consumer Products Affecting the Environment, §1610, Electronic Waste,* http://www.mainelegislature.org/legis/statutes/38/title38sec1610.html, accessed 24 March 2009.

[4] California House and Senate, *Health and Safety Code, Section 25214.9-25214.10.2*, 2004, http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hsc&group=25001-26000&file=25214.9-25214.10.2, accessed, 20 February 2009, and Wilson, Drew, "WEEE and RoHS could be mere warm-up for a new design culture," *Green Supply Line*, 2 February 2006, http://www.nexgendigital.com/green_room_pdfs/6_WEEE_RoHS.pdf, accessed on 19 November 2008.

[5] Wilson, Drew, "WEEE and RoHS could be mere warm-up for a new design culture."

wide savings of $400 million per year. The keys are looking at the entire supply chain making the long-term investments that are necessary to realize those savings. Working at the leading-edge of possibility is the way designers can help themselves and reduce impacts on people and the environment, rather than simply changing products to follow the letter of the law. Within change and environmental regulation, new opportunities are created for people and firms willing to adapt.

As innovative companies figure out how to change their business model in Europe, they can much more easily apply that new knowledge across the globe. The "least common denominator principle" to which Boon refers is also coming into effect in the US as legislation modeled on that of Europe spreads.[6] As large American manufacturers respond to these tighter regulations in some states, it becomes increasingly likely that they will improve their environmental practices in other areas of the country. This will put pressure on federal legislators to harmonize the system, as Rick Goss, the director of environmental affairs for the Electronics Industries Alliance, was quoted as saying in response to the passage of Maine's e-waste bill.[7] Unfortunately, the section banning certain materials widely recognized as toxic is at least as important as the rest, but these bans are generally left out of existing state e-waste regulation.[8]

In the US, this process has not come along simply because of the foresight of

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[6] Harkavy, Jerry, "New Law Forces Manufacturers to Pick Up Recycling Costs," 19 January 2006, Associated Press. http://www.enn.com/top_stories/article/3501 (accessed on 20 November 2008) and Electronic Product Management, "Electronic Waste Recycling Act of 2003: Covered Electronic Waste Payment System," California Integrated Waste Management Board. http://www.ciwmb.ca.gov/electronics/Act2003/ (accessed 20 November 2008).
[7] Harkavy, Jerry, "New Law Forces Manufacturers to Pick Up Recycling Costs."
[8] Electronics TakeBack Coalition, "State Legislation on E-Waste," Tools for Legislators and Advocates.

skilled legislators; it has been pushed along by rising public awareness of the problem and the advocacy of nonprofit groups dedicated to the cause. NGOs have spread the word through the media, bringing the topic into the focus of mainstream environmentalists, consumer-rights advocates, and social justice activists. *Exporting Harm* was the primary catalyst that began the movement, galvanizing people to act in much the same way that *Silent Spring* brought environmentalism into the mainstream in the 1960s. As the issue has gained political salience, news outlets all over the country have run stories on the problem, from the relatively small internet site Networkworld.com to more recognizable outlets such as National Geographic and Scientific American.[9] This media coverage and the continued push of advocates have led to a dramatic expansion in the number of US states with e-waste regulations. It could also be the primary factor motivating future federal action, though the current economic crisis is sure to have a dampening effect on its chances of getting passed in the near future.

The strong push currently being made by nonprofits, in combination with the growing willingness of legislators to respond to green issues, leads to a bright future for e-waste regulation in the US. As will be discussed later, economic incentives are also contributing to improving waste management practices. The US has not caught up to Europe yet, but it is making great strides to bridge the gap.

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[9] Layer 8, "GAO Report Torches US for Dumping Electronic Waste in Foreign Countries," Network World, Inc. 17 September 2008, http://www.networkworld.com/community/node/32852, and David Biello, "Trashed Tech Dumped Overseas: Does the US Care?" Scientific American, Inc., 19 September 2008, http://www.sciam.com/article.cfm?id=trashed-tech-dumped-overseas&SID=mail&sc=emailfriend, both accessed 25 March 2009, as well as Chris Carroll, "High-tech trash: will your discarded TV or computer end up in a ditch in Ghana?" National Geographic, (Jan. 2008), 64.

Chinese Regulations

China has also adopted a number of rules patterned on the EU directives, but researchers suggest that a lack of details and lax enforcement make it unlikely that they will have significant effects in an unmodified form. Despite the fact that China is one of the countries most vitally concerned with how the e-waste problem will be resolved, there is significantly less English-language research available on how their efforts to address the problem have fared. It is clear, at least, that the laws they have put in place in recent years are not sufficient to overcome the financial incentives for recycling electronics in small, informal workshops. These workshops are where many of the health and environmental concerns cited in reference to e-waste arise. The Chinese government has also implemented two pilot programs in "the city of Tsingtao and the province Zhejiang."[10] These programs aim to test how EPR programs can work in China and provide more data as to costs, benefits, and areas where more research needs to occur. Programs like these show that China is committed to solving the problem by taking a long view and creating a system that will work there. Questions of how Chinese manufacturing will remain globally competitive and how a sufficient formal recycling sector will be funded still remain as some of the primary obstacles to solving the problem.

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[10] Kejing Zhang, Daning Guo, Baoan Yang, and Fugen Song, "Design of Electronic Waste Recycling System in China," *Operations Research Proceedings*, Volume 2006, (Springer Berlin Heidelberg, 2007), http://www.springerlink.com/content/g34525177524782r/, accessed 27 March 27, 2009, 268.

In 2002, the Chinese government outlawed the importation of e-waste and in the years since then they have passed a number of laws aimed at creating a system similar to Europe's.[11] They have distinct laws modeled after both the WEEE and RoHS directives, banning certain substances in electronic equipment and requiring manufacturers to pay the costs of recycling their products.[12] These laws are often unclear, however, leading to an uncertain picture of how the situation will change in the next few years. In particular Xianbing Liu et al assert that "Questions such as who will pay, how much they should pay, and how to collect and use the fund, etc….will be a bottleneck in the…smooth implementation of the draft regulation."[13] As the government starts receiving data from its pilot programs, some of these issues may begin to be addressed. Finding out the costs and feasibility of recycling different electronics will allow them to design a program that incorporates a thorough financing plan without putting an uncertain financial burden on industries that they see as critical to the economic success of the country.

Their pilot programs aim to test out two of the leading models of EPR regulation to create a clearer idea of costs, efficiency, and innovation. In Tsingtao, the home of some of China's leading electronics manufacturers, they are creating a system of

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[11] Elizabeth Balkan, "Stepping Up Efforts to Control E-Waste: China Passes Electronic Disposal Law," Sustainablog, Green Options Media, 6 March 2009, http://sustainablog.org/2009/03/06/stepping-up-efforts-to-control-e-waste-china-passes-electronic-disposal-law/, accessed 27 March 2009. See also the Chinese government's regulations, "Notice on Strengthening the Environmental Management of E-waste," "The Management Measures for the Prevention of Pollution from Electronic Products," and "The Ordinance on the Management of Waste Household Electrical and Electronic Products Recycling and Disposal," http://www.sepa.gov.cn.

[12] Zhang et al, "Design of Electronic Waste Recycling System in China," 268.

[13] Xianbing Liu, and Masara Tanaka, Yasuhiro Matsui, "Electrical and electronic waste management in China: progress and the barriers to overcome," Waste Management & Research, Vol. 24, No. 1, 92-101 (2006), http://wmr.sagepub.com/cgi/content/abstract/24/1/92, accessed 27 March 2009, 99.

individual responsibility that will assign the financial burden of recycling to each producer in direct relation with the cost of recycling its products. In Zhejiang, they are using the model more common in Europe wherein a number of manufacturers jointly fund a "producer responsibility organization," or PRO, that will then handle the recycling for all the producers involved and charge them only in proportion to their market share, rather than the particular costs of handling each recycler's products.[14] By taking their time, the problem may worsen in the short term, but they will be able to gather better information that allows them to design a more effective system later. The less democratic nature of Chinese politics may in this case be a boon, as long term solutions can be carefully evaluated before deciding on the best course of action.

Some of the major hindrances to effective Chinese policies regarding e-waste have to do with the costs associated with creating a formal recycling sector with enough scale and scope that it can handle not only the e-waste China produces domestically, but also work through the backlog of imported waste that has accumulated. This reflects a general attitude in China that development and raising income levels is a higher (or at least competing) priority than many other goals and the knowledge that formal processes generally carry higher price tags. Xianbing Liu et al state, "There has been no specific study to examine the reaction of the public to e-waste management in China," but that the results of an informal survey of 1,100 people in 2005 suggest that 57% of people would

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[14] Ibid, 269.

be willing to sell their used electronics.[15] They see the electronics as having value and, in contrast to Europeans, would not be willing to pay someone to process them. Despite this general attitude, the government of China is trying to solve the problem, but do so in a way that gives businesses and local governments some time to adjust to the new policies.

Lax enforcement and pilot projects now can be seen as the first steps toward tighter controls while proceeding in a measured way that does not strongly impede development efforts. The fact that the government is working on the problem is the most important indicator of what the future holds. Also, as EPR spreads to other important nations competing in the electronics manufacturing sector, the drawbacks associated with reduced competitiveness will shrink. Tighter foreign regulations will also force Chinese manufacturers to adopt these policies for their products destined for export, making it much simpler for them to adopt more responsible domestic policies.

Japanese Regulations

Driven by concerns over space limitations and high population density, Japan has followed its own path toward the implementation of e-waste regulations. Beginning in 1991, the Japanese government began to pass voluntary regulations, and by 1998 they had started laying the groundwork for a comprehensive set of reforms on how resources

[15] Xianbing Liu, and Masara Tanaka, Yasuhiro Matsui, "Electrical and electronic waste management in China: progress and the barriers to overcome," 98.

would be used.[16] Their laws had the end goal of creating a closed-loop economy in which all materials are constantly cycled through rather than produced, disposed of, and replaced with virgin materials. From the beginning Japan has been very clear about the goals it intends to promote through e-waste regulation.

In much of the literature on European e-waste laws, the focus is on particular steps that manufacturers must take. The designers of the system focus on creating a set of incentives that will invisibly encourage manufacturers to take positive action. In materials circulated on the Japanese system, the overall goals of the system are much clearer, even to the point of obscuring the concrete steps required of market participants. In a circular addressing the changes to the notification requirements for hazardous substances, the Japanese Ministry of Economy, Trade, and Industry included the reasoning for the overall system and a number of Design for Environment (DfE) goals not addressed by the updated regulation.[17] A key advantage to this is that the government's intent is very clear to manufacturers, who can go beyond the minimum requirements in the spirit, rather than the letter, of the law. Additionally, it keeps a clear and consistent focusing message in front of people to encourage them to make efforts towards an inspiring end goal rather than feeling burdened with the minutiae of each individual step.

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[16] "What is Japan RoHS?" RSJ Technical Consulting, 2006, http://www.rsjtechnical.com/WhatisJapanRoHS.htm, accessed 28 March 2009 and Naoko Tojo, "Analysis of EPR Policies and Legislation through Comparative Study of Selected EPR Programmes for EEE: Based on the In-Depth Study of a Japanese EPR Regulation," Lund University International Institute for Industrial Environmental Economics, September 1999, http://www.iiiee.lu.se/Publication.nsf/$webAll/58DF1C95C2EA586AC1256C370035CC60/$FILE/comm2000_10.pdf, accessed 28 March 2009, 29.

[17] Japanese Ministry of Economy, Trade, and Industry, "Obligation to Provide Information on chemical substances contained in home appliances and PCs from July 1, 2006," found at http://www.rsjtechnical.com/images/Documents/Japan_changes_Jul_2006.pdf, accessed 29 March 2009.

This messaging has been important, but the Japanese government did not leave manufacturers to pick and choose what and how much they would do. To ensure that the law was effective, the Japanese moved from a system that encouraged manufacturers to recycle to one in which they were held legally accountable. The law originally set recycling targets for products within four categories ("large TV sets, refrigerators, air conditioners, and washing machines") to begin with and set recycling targets based on the weight of collected materials. One drawback is that the law did not include specific mention of hazardous substances, risking that manufacturers would not invest in technologies to process the relatively small amounts of hazardous substances in their products. Fortunately, Tojo found that manufacturers saw the law only as a minimum and planned to build facilities that could handle hazardous wastes as well.[18] The law now also incorporates microwaves, PCs, copying machines, and clothes dryers.[19]

In 2006, the Japanese government updated the system, reflecting some of the innovations that had occurred in Europe during the intervening years. According to RSJ Consulting, "Manufacturers and importers of computers, televisions, refrigerators, washers & dryers, microwaves and air conditioners [now] must label their products to indicate presence of the six RoHS substances…[and] importers…must now meet the Design for Environment (DfE) criteria required of domestic manufacturers."[20] This is a major step, one that has yet to catch on in the United States, but, as noted above, has the

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[18] Naoko Tojo, "Analysis of EPR Policies and Legislation through Comparative Study of Selected EPR Programmes for EEE," 49.
[19] Japanese Ministry of Economy, Trade, and Industry, "Obligation to Provide Information on chemical substances contained in home appliances and PCs."
[20] "What is Japan RoHS?" RSJ Technical Consulting, 2006.

potential for greatest impact on the overall production process for electronic equipment. It is also one of the most contested parts of the European system.[21]

Japan's efforts have not been quite as extensive as those of Europe, but they have met with marked success as manufacturers have met the recycling targets set for them and DfE principles have been incorporated into business models.[22] One of the main drawbacks pointed out by Tojo is that Japan's laws place the financial responsibility on end users, increasing the likelihood of illegal dumping.[23] On the other hand, it is expected that Japanese citizens will feel a social responsibility to follow the law. In this scenario, people will have an incentive to buy products that are less expensive to recycle, giving manufacturers who incorporate DfE into their productions processes an added benefit.[24] Though it seems less likely in the Japanese context, another possible drawback is that placing the costs directly on consumers will breed political opposition to the law itself.

As the system matures and people come to accept the value of e-waste regulation, Japan will benefit from a ban on at least as many substances as those already outlawed in Europe. This, along with widening the range of products covered by Japanese e-waste laws, will help to ensure that the country meets the goals with which it began transforming its economic system. There are many other substances that should eventually be banned, but as with the first six substances, it will be less expensive to wait for Europe or another region to do the research into viable replacement substances before

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[21] Naoko Tojo, "Analysis of EPR Policies and Legislation through Comparative Study of Selected EPR Programmes for EEE," 65.
[22] Ibid., 53.
[23] Ibid., 54.
[24] Ibid., 56.

following their lead.

Conclusion

Europe's system is still the most extensive mandatory system of producer responsibility among the world's major economies. Questions of competitiveness, efficiency, and evasion of the law, however, have led other countries to experiment with different systems intended to accomplish the same final goal. In China and the US in particular, manufacturers are very worried about losing ground to foreign competitors not subject to the same legal requirements they are. Japanese companies have successfully managed to avoid bearing the entire incidence of recycling costs, instead including them in a separate price charged to consumers at the time of sale.

As countries experiment, they are likely to discover new ways to achieve even greater recycling and economic efficiency. One shortfall of the current systems is that they do not sufficiently encourage consumers to play an active role in recycling. Reducing the barriers to recycling was a great first step, but it will be much more effective if consumers are charged a refundable deposit at the time they purchase an item. People will be much more motivated to return the item if they receive five to ten dollars back than if they are simply doing the right thing. The next chapter will lay out how some of the details of such a system might look in practice.

Thinking Outside the Bottle: Refundable Deposits for E-Waste Recycling

It is clear that in the United States, many people will not willingly improve their recycling habits without significant rewards for cooperating or punishments for non-compliance. Creating a deposit-driven system of incentives could have an effect as great as that of the "bottle bills," under which the consumer pays a fee (five to ten cents) at the time of purchasing a beverage that is later returned when the consumer returns the bottle to the store of purchase. These bills have been tremendously effective at increasing the rates of recycling for aluminum cans and glass bottles in the states where they have been adopted. In Michigan, the only state to have a $.10 refund on its cans and bottles consistently sees return rates of almost 100%.[1]

If a similar system were adopted for electronics, under which consumers paid a deposit of a dollar or more when they bought a product containing electronic components or hazardous chemicals, recycling rates for these products would be expected to rise greatly. There are a few different ways to design a system like this, each with its own pros and cons. Two systems in particular stand out as having the potential to raise recycling rates for e-waste to very high levels at a moderate cost. One combines the deposit model with a more traditional EPR program common in Europe and many US states. The other would involve a partnership with a company like RecycleBank that

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[1] Container Recycling Institute, "Bottle Bills Promote Recycling and Reduce Waste," *Bottle Bill Resource Guide*, 2007, Container Recycling Institute, http://www.bottlebill.org/about/benefits/waste.htm, accessed on 19 November 2008.

credits households a certain value for the volume of recycling they contribute each month. Another system, designed by Kahhat et al, has promise, but may run into obstacles with consumer behavior due to its complexity and its reliance on individuals to play an active role in the recycling market.

Different Ways to Utilize Deposits for Maximum Effectiveness

One way to achieve greater recycling rates is to combine a deposit system (like that used for beverage containers) with traditional EPR legislation in order to improve the efficiency of collection and increase rates of return. By requiring manufacturers to pay the costs associated with recycling their own products and charging consumers a refundable deposit, the incentives for all parties will be aligned to lead to better outcomes. Though the simplest option would be to levy a deposit that incorporates the cost of recycling and then refund a smaller amount, it would add a high up-front, visible cost to electronics that would be likely to lead to consumer outcry. Products that currently cost around $25 to recycle would have to carry an initial deposit of $30 or more in order to give a great enough incentive to ensure proper disposal. Doing it this way, however, would have the potential to drive consumers across state or national boundaries to buy products that do not carry the heavy recycling fee, angering manufacturers and retailers and undercutting the effectiveness of the system.

Under an ideal scenario, producers would bear the costs of recycling their own products, though they could be collected alongside those of other manufacturers in a

single collection system as suggested by Rossem, Tojo, and Lindquist.[2] Individual responsibility would give them an incentive to make their products more easily recyclable, removing chemicals that make the process more expensive and standardizing the materials used for certain applications among all members of a given industry. By incorporating these costs into the production side of the equation, consumers will not be confronted with a $30 or more deposit because that cost would be included in the final price of the good. A deposit between $5 and $15 would be enough to motivate the majority of people to return their old equipment without drastically reducing sales and leading to a public outcry. People or organizations running fundraisers could collect electronics worth hundreds of dollars in deposits (increasing collection rates still further), but consumers buying just one or two products would not have the incentive to drive out of their way to get products in another state. Ideally, this would be a federal law in order to eliminate any potential for consumers to avoid paying the fees.

Kahhat et al also detail a deposit-driven system in the journal *Resources, Conservation, and Recycling*. Their system sets up a more complex set of rules in which every electronic item sold will be accompanied by a deposit managed electronically by the federal government. When a consumer needs to dispose of their equipment, they consult an online recycling market in which companies compete to offer the highest

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[2] Chris van Rossem, Naoko Tojo, and Thomas Lindquist, "Extended Producer Responsibility: An Examination of Its Impact on Innovation and Greening Products," The International Institute for Industrial Environmental Economics, September 2006, http://www.greenpeace.org/international/press/reports/epr, accessed 13 March 2009, 7.

deposit refund (the original deposit plus interest accrued minus the costs of recycling).[3] Through this mechanism, recyclers with the most efficient methods will be able to offer higher refunds to their clients and in turn they will be rewarded with a greater number of customers. A major drawback of the system would be the amount of confusion that would arise in a system with so many competing actors.

A major barrier to recycling in the past has been the complexity of the system and an overabundance of rules. Requiring consumers to use an online recycling market in which recyclers will not only have different prices, but also different collection methods, runs the risk of alienating new users or people with less access to or familiarity with the internet. Also, by requiring the deposit to include the cost of the recycling process, the price tag for such services may negatively affect consumer behavior, discouraging them from buying new products and alienating manufacturers.

Under the combined EPR-deposit system, the initial deposits will be lower and they will be entirely refunded, while recycling costs will be internalized into the regular price of the product, masking it from the consumer. Recyclers will not be competing for consumer dollars under the combined system, but instead will compete to attract large electronics manufacturers. This will make the system simpler for the consumer and mitigate the shock value and confusion of a $20-$30, partially-refundable "recycling fee/deposit." Instead corporations will do the heavy lifting involved in finding the most efficient recyclers and creating wholesale contracts that guarantee the recyclers

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[3] Kahhat, Ramzy, Junbeum Kim, Ming Xu, Braden Allenby, Eric Williams, and Peng Zhang, "Exploring e-waste management systems in the United States," *Resources, Conservation, and Recyling*, (52.7), 960.

economies of scale. Different regions will be free to decide whether curbside collection service will be provided or whether drop-off sites at retailers, libraries, police stations, or city hall will be more appropriate. With this method, corporations or local authorities will have the ability to more easily monitor their recycling partners to ensure that they meet health and safety standards and follow all relevant export laws.

Kahhat et al point out that an important consideration in the design of the system is how to deal with exported e-waste. They briefly discuss two options, only allowing domestic recyclers to earn the deposit, or setting up a system that allows certified foreign companies to compete within the system as well.[4] As will be discussed in greater detail below, a transboundary e-waste recycling system has the potential for great economic benefits at little or no environmental cost. Unfortunately, within the current system most e-waste processed in the developing world is treated in an extremely dangerous manner. As a result, many companies or governments within the US require domestic recycling of their electronics. Under the ideal scenario, then, electronics collected under the new system should all be treated within the US until stronger regulations in the developing world are established or a more rational process is developed.

Within either of the two preceding models, community groups would be able to take advantage of the deposit system to institute fundraisers that involve collecting e-waste in order to claim the deposits for youth sports and other beneficial activities in order to capture more of the benefit. In this way, the elderly and other citizens who do not

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[4] Ibid., 963.

have the ability or the time to return their own recyclables could give them to these groups, getting rid of their waste and helping the community at the same time. It would have the added benefit of motivating people to give away or return old electronics they otherwise would have stored. In California alone, government studies have indicated that around "6.1 million old TVs and computer monitors" are being stored in "garages, closets, and back bedrooms" because people do not have a simple way to get rid of them responsibly.[5] Giving a financial incentive to return obsolete products can help to avoid this problem and get valuable resources back into the system.

Another system that has had success running on a platform of economic incentives for recycling is RecycleBank, an East Coast company that partners with municipalities and recycling companies to get people to recycle more. According to a Newsweek article from October, 2008, recycling rates in some cities have increased by as much as "tenfold" since the program began. RecycleBank uses a system of RFID tags embedded in its recycling bins to measure how much each household it serves contributes and then gives each household "2.5 points for every pound they recycle…the monthly max is $45."[6] People and cities have responded. The company is currently expanding from its territory in the Northeast into the South and the Midwest. This is great evidence that programs that give people a financial incentive to recycle can be very successful.

RecycleBank and other ideas like it are a way to get more people behind the idea

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[5] California Integrated Waste Management Board, "6.1 Million Old TVs and Computer Monitors Stockpiled in California," Press Release, 12 December 2001, http://www.ciwmb.ca.gov/Pressroom/2001/December/048.htm, accessed 29 March 2009.
[6] Naughton, Keith and Daniel McGinn, "Saving the World for a Latte," *Newsweek*, 6 October 2008, 48.

of recycling. State governments concerned with fighting the rising tide of e-waste could build a similar rewards system simply by creating a deposit-driven system on electronics, or they could partner with companies like RecycleBank to create an integrated system that would give people a bonus for returning valuable or hazardous materials. For example, RecycleBank could continue their $45 limit on traditional commodities like glass, plastic, paper, and metals, but allow families to go past that cap when returning e-waste. In return, RecycleBank would get small portion of the deposit to cover its costs and adequately reward them. One drawback of this model is that community collections to benefit particular causes will be less likely, but the overall rate of recycling may increase due to the ease associated with taking these items as part of the regular recycling stream. To ensure these items are handled appropriately, the collection company could designate a monthly or semimonthly collection day on which electronics would be picked up. In areas where there would be little demand for this service, they could require their customers to call ahead of time to check that the trucks have adequate capacity when they are returning sensitive items.

By expanding to poor or urban communities, they can give economic incentives for recycling to people who will benefit proportionally more from the program. In the same way that the poor bear the costs of a tax or fee disproportionately more than the affluent, they also benefit more from programs that deliver economic incentives, making them a potential source of important increases in recycling of electronics. One difficulty, however, will be the free-rider problem that might occur. In poor communities, many people live in apartment buildings where everyone would have to split the benefits from a

recycling program unless more detailed accountability methods could be developed. These communities, however, are a huge potential source of recycled materials due to high population density and traditionally low return rates for used materials.

Dealing with Existing and Orphaned Waste

To start a deposit-driven system, there will have to be specific mechanisms to deal with waste that is currently stored. Existing stockpiles of electronics did not require a deposit at the time of purchase, creating the need for a funding mechanism to deal with their disposal. In some cases, devices labeled as "orphan waste" were produced by manufacturers that no longer exist, making producer responsibility impossible. This could be incorporated by offering the same "refund" from the state that a new item would receive. Requiring recyclers to accept a certain percentage of old products for free would also encourage collection of old electronics and through market mechanisms the costs of dealing with the old electronics could be passed on to manufacturers (and consumers) in proportion to the number of goods they sell. Due to political pressures from industry and taxpayers, these systems could be difficult to instate, however, leading to the strong possibility that old goods would still be treated under the old system, requiring consumers to pay a fee upon disposal. Even under this system, the public still stands to benefit greatly. Due to the rapidly rising production of electronic products, many more will surely be stockpiled in the coming decades if no incentive is given for consumers to recycle their goods. EPR legislation is an improvement on the old system because it

eliminates the cost to consumers for recycling, but it still remains a hassle and an obligation. By rewarding responsible consumers and making a "hassle" into a profitable activity, we can remedy the existing reluctance to recycle.

Increasing Recycling of the Most Hazardous Products

To encourage the highest collection rates on items that have the highest "environmental weight," deposits should be variable. They should be based on the environmental costs associated with the materials contained within the product. This will help capture the value of environmental externalities in the prices consumers pay, giving them incentives to select products with smaller environmental impacts, in line with the "quotes for environmentally-weighted recyclability and eco-efficiency" concept pushed by Jaco Huisman et al.[7] By adding the deposit to the price tag, companies incorporating eco-design principles will gain a price advantage over companies less concerned about their impact. Unlike beverage containers, which are returned quickly and carry a minimal, equal deposit, the front-end deposit on electronics would be large enough to affect consumer behavior because they would not expect the deposit back for a number of years. By the same token, the larger, variable deposits would lead to higher recycling rates, with the most dangerous products being returned most often.

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[7] Jaco Huisman, Ab Stevels, Thomas Marinelli, Federico Magalini, "Where did WEEE go wrong in Europe? Practical and academic lessons for the US," Proceedings of the 2006 IEEE International Symposium on Electronics and the Environment, 2006, http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1650039, accessed 13 March 2009, 83.

Conclusion

Many of the roots of the e-waste problem can be addressed by combining a deposit-driven system with extended producer responsibility and current curbside recycling in order to maximize the number of people willing to get involved. While overhauling the system, governments need to take into account the roles that confusion, price signals, and consumer inertia play to determine how waste is handled.

They should choose a system that is simple for consumers; that does not make people feel unjustly penalized for protecting the environment; and that gives people enough financial incentive to motivate them to return their equipment. Facilitating curbside recycling that rewards people for returning old electronics or allowing people to take their equipment to local collection points to receive their refund will give people the most incentive to return old equipment and protect the environment at the same time. Manufacturers will bear the financial burden of the program, but their role will not have to be any greater than it will be under existing EPR systems.

As we improve the financing and framework of e-waste collection and recycling, we must also help create a system that allows people to thrive. The quest to save the environment is in many ways a quest to protect people. Low-income communities are often affected most by environmental problems, but left out of initiatives to solve them. Refundable deposits may help some people earn money by collecting recycling, but they are not the comprehensive solution that low-income people need. Providing training and

family-supporting jobs in the electronics recycling revolution may be that solution, giving people an income and a share in protecting our environment.

E-Waste and the Green Collar Economy: Creating Jobs for People and the Environment

Van Jones, Majora Carter, and others are spearheading a campaign to create a paradigm shift in the United States that moves us towards an economy that includes respect for both workers and the environment. In his book *The Green Collar Economy*, Jones briefly explores how these principles relate to waste management and recycling programs. To make recycling and waste management more fair and sustainable, it is necessary to explore this relationship in greater detail. As authors Paul Hawken, Amory Lovins, and L. Hunter Lovins state, "Social wounds cannot be salved nor the environment 'saved' as long as people cling to the outdated assumption…that the *summum bonum*…is to use more natural capital and fewer people…The true bottom line is this: A society that wastes its resources wastes its people and vice versa."[1]

The government, impelled by voters, must change the rules of the game to reflect values most Americans already agree on. The rise of humanitarian NGOs dedicated to fixing the ways we deal with electronics recycling reflect the high level of uneasiness people feel when they hear that children in the US and abroad can be poisoned by our waste. Their advocacy and their creation of tools to facilitate the spread of e-waste regulation have played an important role in getting this issue into the public's awareness. The key issue is that governments need to create opportunities, either directly or

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[1] Hawken, Paul, Amory Lovins, and L. Hunter Lovins, *Natural Capitalism: Creating the Next Industrial Revolution*, (New York: Little, Brown and Company, 1999), 55.

indirectly, for low-income workers to learn the skills necessary to divert used electronics from the waste stream or recycle them safely. By employing more people to ensure that we use less resources, we can create a more equitable and sustainable life for ourselves and there is already evidence that this can lead to better overall economic outcomes in some cases. Jones, Carter, and other leaders of the environmental justice movement have projected this message strongly and clearly, giving hope to many environmentalists and many less-skilled workers. Within the electronics recycling process, governments and nonprofits can be the catalysts that allow low-income people to capitalize on their entrepreneurial spirit by providing training in computer repair and business skills and providing small loans to enable people to start small businesses.

In the last few years, "green-collar jobs" have become familiar political terms for many and Van Jones points out that "Community college boards across the land began offering green-collar job training programs" since 2007, when the idea first appeared.[2] This is a very positive development, but it also reveals one of the main problems of green-collar job creation—that it often draws from a relatively educated labor pool. The people around whom Jones and others focus their efforts when they speak of green jobs rarely have access to a college education. To increase the number and quality of green collar jobs for people from low-income backgrounds, best-practice e-waste laws need to come into effect across the nation. A study issued by the Commission of the European Communities acknowledges that in Europe, the implementation of e-waste laws has

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[2] Jones, Van and Ariane Conrad, The Green Collar Economy: How One Solution Can Fix Our Two Biggest Problems, (New York: HarperOne, 2008), 191.

increased economic activity that "brings revenue and employment to a waste treatment sector employing much manual labour," which is likely to benefit less-educated communities.[3] To ensure that everyone has access to these new job opportunities, alternative job training approaches need to be offered at the same time that community colleges include electronic waste recycling in their new programs. Two alternative types of job-creation and training programs that target the most economically marginalized sectors of society are government job training and prison-to-work training. These both have some potential for positioning disadvantaged people to take part in the rise of the green economy and can augment the success of more conventional increases in higher education offerings, though neither of them is a silver bullet that will instantly solve the problem.

Government-Sponsored Job Training Programs

Much of the analysis regarding the effectiveness of government-sponsored job training programs does not yield strong positive results, but there is hope that more intensive programs will yield better results. Daniel Friedlander, David H. Greenberg, and Philip K. Robins undertook a comprehensive study on the effectiveness of government job training programs and found that income gains varied widely, were sometimes

[3] Commission of the European Communities, "Commission Staff Working Paper Accompanying the Proposal for a Directive of the European Parliament and Council on waste electrical and electronic equipment (WEEE): Impact Assessment," Brussels, http://ec.europa.eu/environment/waste/weee/pdf/sec_2008_2933_ia.pdf, accessed 14 March 2009, 7.

negative, and that those gains "although substantial, are not large enough to lift most families out of poverty."[4] Certain job-training programs, they found, can be effective, but even the best programs only succeeded in helping the participants increase their wages by $1,000 to $2,000 per year. Robert J. LaLonde echoes this finding and questions if "an increase in employment rates instead of wages…simply helped participants to 'displace' nonparticipants from jobs."[5] Based on the fact that longer or more intensive programs like Job Corps increase earnings more among disadvantaged youth, they both assert that to become effective at reducing poverty, training programs need to become more intensive. In the realm of "green-collar jobs," it seems that the extremely disadvantaged are again likely to fare poorly unless the government creates longer, more intensive job training programs.

This does not mean that everyone in working-class communities is going to miss out on the green revolution. As community colleges and vocational schools retool their curricula, more people will be able to gain well-paid employment in green jobs without a four-year degree. Community college professors are touting green training programs as a great way to beat the economic downturn and earn high wages in growing industries.[6] In many areas, such as electrical engineering or plumbing, it takes very little extra training

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[4] Friedlander, Daniel, David H. Greenberg, and Philip K. Robins, "Evaluating Government Training Programs for the Economically Disadvantaged," *Journal of Economic Literature*, Vol. 35, No. 4, (Dec. 1997), 1832-1833.
[5] LaLonde, Robert J., "The Promise of Public Sector-Sponsored Training Programs," in *The Journal of Economic Perspectives*, Vol. 9, No. 2, (Spring 1995), 162.
[6] Sutter, John D., "Growing excitement, expectations for green job corps," CNN Living: Planet in Peril, 2 March 2009, http://www.cnn.com/2009/LIVING/03/02/green.jobs.training/index.html, accessed 3 March 2009.

for people training to pick up green skills. The situation is very similar for computer hardware repair classes. People trained in computer repair techniques can be employed by electronics recycling companies to help divert functional components from the recycling process.

The Potential for Prison-to-Work Programs

Prison-to-work programs are another way that e-waste can be reprocessed responsibly while creating job opportunities. These programs are a very polarizing topic, touted by some as a way to reduce recidivism, fund the prison system, and "spur the economy," but denounced by others as "exploitation and unfair business competition" that hinders non-prison employers.[7] Formerly incarcerated individuals are rarely successful in the labor market, however, leading to a high potential payoff to even minor successes in prison training programs. Training inmates to disassemble and reassemble electronic equipment offers a way to cheaply handle the electronic waste stream that is often diverted overseas while also building skills that could lead to higher-wage jobs after release. Because of the hazardous components of e-waste, it is important that inmates receive all the safeguards given to workers in the rest of the community to avoid creating yet another situation in which society takes from the "have-nots." If handled properly,

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[7] Atkinson, Robert D., "Prison Labor: It's More than Breaking Rocks," Policy Report (Progressive Policy Institute, May 2002), http://www.ppionline.org/documents/prison_labor_502.pdf accessed 2 March 2009 and Beth Schwartzapfel, "Your Valentine, Made in Prison," *The Nation*, 12 February 2009, http://www.thenation.com/doc/20090302/schwartzapfel, accessed 2 March 2009.

this solution could also be a way to avoid the dislocation of private sector jobs that can accompany the creation of prison labor forces.[8]

Currently, UNICOR, the federal prison employment corporation employs around 1200 people to handle electronics recycling in locations around the United States.[9] The workers are recruited to work voluntarily for pay and a percentage of the money they earn is used to pay fines, victim restitution, and child support. They receive training and work in facilities that are required to meet Occupational Safety and Health Administration rules.[10] As more states pass EPR regulations requiring manufacturers to pay fees associated with recycling their products, this program and similar state programs can be expanded. Private companies play a large role in this market as well, which will give inmates with these skills an opportunity to find work after they are released. Former inmates will also have skills that would allow them to work in other industries where computer hardware repair skills are in demand. More stringent legislation addressing current flows of e-waste exports could also boost the demand for services of this sort, making it a potential growth industry.

UNICOR, as an employer that hires from a pool of inmates should take all available precautions with the health of its workers, given that they have little choice to walk off the job or organize to demand better working conditions. Unfortunately, a 2003

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[8]Beth Schwartzapfel, "Your Valentine, Made in Prison."
[9] UNICOR, "Recycling: Overview," Federal Prison Industries, Inc., http://www.unicor.gov/recycling/, accessed 2 March 2009.
[10] UNICOR, "Recycling: Environmental Compliance," Federal Prison Industries, Inc., http://www.unicor.gov/recycling/protect.cfm?navlocation=EnvironmentalCompliance, accessed 2 March 2009.

study by the Silicon Valley Toxics Coalition and the Computer TakeBack Campaign found that instead of using a "closed-system mechanical crushing machine" to process broken CRTs as private sector recyclers commonly do, UNICOR employed "8-12 inmates in a caged area blocked with strips of plastic sheeting, smashing CRTs with a hammer."[11] Other inmates spend their time at "makeshift tables" dismantling equipment with inadequate tools that often require them to smash parts of the items, creating glass and plastic shards and dust. Though part of UNICOR's effort to be green, many issues need to be addressed before UNICOR can be counted as part of the true green-collar economy. In the wake of the report, Dell cancelled its contract with UNICOR and the Basel Action Network, a non-profit focused on ending trade in toxic substances, now asks companies to commit to avoid any use of prison labor in electronics recycling as part of their "Electronics Recycler's Pledge of True Stewardship." The pledge seeks to uphold the highest standards for employee and environmental health and safety.[12] UNICOR (or any other prison labor system that intends to employ inmates to process old electronics) needs to address worker health and safety to uphold a key component of the truly green economy, respect for employees' health and well-being. Treating prisoners with respect while they work in prison will allow them to be healthier, happier, and more productive after they leave and hopefully make them feel more valued by society. Disenfranchising people for their criminal acts is not a productive way to reintegrate them into society after

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[11] Davis, Sheila and Ted Smith, "Corporate Strategies for Electronics Recycling: A Tale of Two Systems," Silicon Valley Toxics Coalition and the Computer TakeBack Campaign, 25 June 2003, http://www.etoxics.org/site/DocServer/prison_%5Cnal.pdf?docID=201, accessed 4 March 2009.
[12] "Electronics Recycler's Pledge of True Stewardship," Basel Action Network, http://ban.org/pledge/electronics_recycler_pledge.pdf, accessed 27 October 2008.

they are released.

As the case of UNICOR vividly demonstrates, just finding a job in a green or environmentally-friendly industry does not mean that a person has found the path to higher wages and better benefits; voters, unions, and politicians need to play a role in encouraging or requiring green employers to provide the kind of employment people want. According to a report by Green Jobs First, there is much promise in fast-growing green sectors, especially in areas targeted for increased federal and state spending.[13] But with nationwide declines in manufacturing jobs and the often nonunion makeup of the labor force in green sectors, policymakers and employers are fighting against the current to find ways to keep wages and benefits high. According to the report, about "one-quarter of the plants [surveyed] do not pay enough to meet the estimated budget for a single adult with one child."[14] Nonetheless, Norcal, a recycling plant in San Francisco that was profiled in the study shows the promise of building state-of-the-art recycling facilities. They pay their workers a starting salary of $20 an hour that rises to $29.50 and boast safe working conditions and excellent results.[15] They are even held up by recycling advocates as a full-scale pilot program for what other cities should be doing.[16]

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[13] Mattera, Philip, *High Road or Low Road? Job Quality in the New Green Economy*, Good Jobs First, 3 February 2009, http://www.goodjobsfirst.org/pdf/gjfgreenjobsrpt.pdf, accessed 3 March 2009.
[14] Ibid, 12.
[15] Ibid., 27.
[16] Eddings, Amy, "Can NYC Learn Recycling Lessons from San Francisco?" WNYC Radio, 25 November 2002, http://www.wnyc.org/news/articles/38899, accessed 3 March 2009.

The Potential for High-Quality, Family-Supporting Jobs

With such great success in creating great jobs for its workers while handling mixed recycling, Norcal's story indicates that recyclers who handle only electronics, a high-value waste stream, have the potential to produce similar results. The Institute for Local Self-Reliance produced a study in 2006 that reinforces this view. It shows that computer reuse programs can support 296 jobs per 10,000 tons per year, more than triple the number of the next highest waste stream, textiles reclamation.[17] This means that responsible government policies to reduce the flow of e-waste to landfills and incinerators will support new jobs in the recycling industry with the potential to be among the best paid in the industry. In a faltering economy, finding ways to create value from resources that are already in circulation can help us to avoid relaxing environmental regulations to spur job creation. By focusing training efforts on low-income communities, we can ensure that a greater portion of the jobs go where they are most needed.

In addition to taking jobs in large corporate firms, small businesses and new entrepreneurs can help solve the e-waste problem while creating financial stability for themselves and their families. People trained in computer hardware repair and recycling strategies can help to bridge the digital divide that prevents many people in low income communities from gaining the skills necessary for many high-paying jobs. With the skills learned in vocational schools, job training, or prison-to-work programs, they can play an

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[17] "Recycling Means Business," *Waste to Wealth*, Institute for Local Self-Reliance, 2006, http://www.ilsr.org/recycling/recyclingmeansbusiness.html, accessed 3 March 2009.

integral role in their communities. Right now, most people just store their old electronic equipment in their basements, closets, and garages. Non-profit groups like the Electronics TakeBack Coalition are working to change this by pushing large companies to pay the costs associated with recycling their equipment once it becomes obsolete. This can be integrated with a ground-up approach in which people trained in the requisite skills can participate, collecting equipment from their community and refurbishing it or mining it for parts that can be reused or resold. Not only would this generate income for the recyclers, they would also be able to provide low-cost computer equipment back to their community.

This would require entrepreneurial spirit and access to credit, but people from low-income neighborhoods have risen to similar challenges before and will do it again. Growing microfinance networks and cooperative business plans will help make the path easier. "Microlenders" such as ACCION USA and Alante Financial are part of a growing industry that seeks to provide "affordable and professional financial services in communities which banks typically do not reach."[18] Microfinance has had marked success in the developing world and has great potential for areas in the US where people with a great business idea often cannot get credit from conventional banks. Cooperatives have also shown potential in the fight against poverty. Community leaders in the South Bronx started Rebuilder's Source, a construction supply company that sells materials that had been destined for the dump. Every employee is also an owner, and the organization

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[18] "About Us," Alante Financial, http://www.alantefinancial.com/index.php?/about-us/.

Green Worker Cooperatives plans to expand the model in the community.[19] People with skills in electronics repair could work from that model and come together to create a community resource and contribute to the green-collar economy.

As more states pass producer responsibility bills, creative entrepreneurs can expand their businesses by finding ways to connect with local government and businesses in need of a way to handle the flow of used electronics that follows. Some of the electronics will have to be handled by companies that simply crush the items and sort them by material, but much of the "waste" stream will contain valuable components. Working with local leaders, recycling entrepreneurs can organize recycling drives for people to drop off old equipment that they did not know how to dispose of properly. Teaming up with local libraries, schools, and nonprofits, these businesses could sell the remanufactured computers and other equipment to help increase access to digital resources and improve education in their communities. By charging a small fee for accepting old items, they can pay the costs associated with dealing with unusable items and generate profit through computer and hardware sales. An advantage of creating programs like these on a community scale would be the ability to create a rate structure and payment options that would reflect the ability of their customers to pay for services.

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[19] Carr, Philip, Video: "Green Worker Cooperatives," in *Stories from the Green Collar Economy*, Green for All, 2009, http://www.greenforall.org/resources/the-green-collar-economy/success-story, accessed 3 March 2009.

Protecting the Economy in the Process

Bringing recycling jobs back to the developed world, where most e-waste is created, can be achieved without ignoring economic concerns. There is an all too common conception that because labor is cheaper in China, India, and other developing nations, it will always be cheaper to have electronics dismantled and mined for valuable resources there. A recent study undertaken by Umicore, a materials technology group, reveals that in the case of certain components at least, both developing and developed countries can benefit from a two-way flow of e-waste.[20] In the developed world, more sophisticated processes and greater access to capital make it possible to reclaim much more of the valuable material contained in old electronics.

Umicore analyzed the processes used to remove gold from one ton of printed wiring boards (PWBs) in India and another at their recycling plant in Belgium. They found that the overall process not only reduced environmental damage to almost nothing, but resulted in a net economic benefit of €2,500, as opposed to a profit of only €500 in the low-tech sector in India, even factoring in the costs of sending the scrap to Belgium.[21] They also emphasized in their analysis that the improved yield would have benefits for all parties, as Belgian refiners could offer a higher price to materials dealers in India and ship the precious metals back to India to avoid draining valuable resources from the

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[20] Umicore Group homepage, http://www.umicore.com/en/, accessed 22 March 2009.
[21] David Rochat, Christian Hagelüken, Miriam Keller, and Rolf Widmer, "Optimal Recycling for Printed Wiring Boards (PWBs) in India," Umicore Precious Metals Refining, 2007, http://www.preciousmetals.umicore.com/publications/articles_by_umicore/electronic_scrap/show_OptimalRecyclingForPWBinIndia.pdf, accessed 5 March 2009, 8.

Indian economy.

This reveals that re-examining current thinking about how e-waste is dealt with can yield very positive results. By moving a very hazardous part of the process (involving heavy use of cyanide) back to the developed world, everyone can win. Some of the safer, labor-intensive stages may be safe enough to carry out in the developing world, but stages requiring the separation of valuable but toxic elements are better left to high-tech smelters in the developed world. There is the possibility that PWBs are a rare case, but hopefully cutting-edge research will find more and more ways to make the recycling process in the developed world more profitable from environmental, economic, and social standpoints.

Conclusion

There is much to be gained from a holistic approach to waste management, but it must be emphasized that there will be conflicts along the way. There will be some cases in which change will be relatively simple, a matter of adopting better policies to save money and material, but there will be other times when competing public priorities make those decisions more difficult. In particular, there will be friction between those proposing the new approach and those who believe the economy's only goal is efficiency and claim that adding restrictions on what businesses are allowed to do will destroy jobs and hurt the economy. Proponents of the green economy need to be equipped with research and ideas to dispel that myth to be able to convince more people of the fact that

an economy that gives no value to resource conservation cannot sustain itself forever. Perhaps more important when talking with proponents of growth is to show them that recycling has become a profitable enterprise, adding value to local economies and sustaining good jobs.[22] Often, however, these people ignore hidden costs that are eventually paid by governments or people many years down the road. They also discount the rights of the people working to fuel the economy to earn a decent living. A rational system of waste management will take into account present and future costs in order to find the most rational, economic way to turn waste into material inputs and finished goods while maintaining the dignity of its employees

[22] "Recycling Means Business," *Waste to Wealth*, Institute for Local Self-Reliance.

Conclusion

E-waste threatens to be one of the major environmental problems of the 21st century as telecommunications become ever more integrated into our daily lives and production of household electronics continues to grow around the world. Europe has started the trend towards dealing responsibly with end-of-life electronics, but most other major economies are still trying to put systems into place that can deal with used electronics on a large scale. The European WEEE and RoHS directives have set a high standard to reach, but that nevertheless have many of their own failings. Designing new ways to improve incentives for eco-design and usher end-of-life electronics into proper disposal channels are key challenges that, once met, will bring many benefits to the environment and, in the long term, to the economy.

As Europe's directives continue to evolve, other major economies are adopting similar programs that try to achieve the same goals as Europe, though they differ in scope and ambition. Japan adopted e-waste laws around the same time as Europe, but they do not cover as many goods as those in Europe. One of the main advantages of Japanese regulation, however, stems from the culture of respect for authority and group responsibility present in their society. Manufacturers and citizens there have demonstrated a willingness to comply with e-waste laws and even go above and beyond legal mandates. In the US, the spread of e-waste legislation has yet to reach the national level, but a network of highly committed NGOs has pushed for state-level legislation that is spreading across the country. Major economic powerhouses like California,

Massachusetts, and New York City have already passed bills requiring extended producer responsibility, making it likely that manufacturers will learn how to comply with existing laws and plan for how to handle regulation in ever-widening areas. In China, e-waste laws similar to Europe are in effect now, as well as a ban on the import of e-scrap, but enforcement agencies have not been able to stop the huge volume of informal recycling occurring in different regions around the country. New regulation is also vaguely worded, making it difficult to follow precisely, but two pilot projects promise to yield information that will allow the Chinese to government to improve the ways it handles e-waste and improve existing laws.

Despite the fact that European-style legislation has been gaining momentum around the world, other types of systems to handle e-waste should also be considered. In the US, complementing the producer responsibility system with a refundable-deposit system would give consumers incentives to play a proactive role in preventing e-waste. Bottle bills and companies that offer incentives for households to recycle more have both shown that financial incentives can quickly lead to positive changes in behavior. Keeping the system simple for both consumers and companies is a key component of the process, reducing the risk of political backlash or confusion that could undermine government efforts to solve the problem.

Examining the flows of e-waste and finding ways to improve the current system can make market solutions more effective and reduce the burden on government "command-and-control" regulations. Umicore, a smelting company in Belgium, has shown that it can increase profits six times by importing nonfunctional printed wiring

boards from India. In the process, it reduces environmental contamination to almost zero and creates an opportunity to benefit everyone involved in the process. Solutions like this need to be explored in greater depth to find situations where improving economic and environmental outcomes can be done simultaneously. There is much room to improve the recycling process within the developing world, as well. Creating a formal sector to handle only the most dangerous steps in e-waste processing would allow developing countries to take advantage of lower labor costs without making large health and environmental sacrifices. Technological improvements, like centralized databases of recycling information for all types of products, can also contribute to greater efficiency in e-waste recycling.

In the US, the idea of “green-collar jobs” is gaining momentum, fostered in part by advocacy groups led by Van Jones, Majora Carter, and others. This momentum can carry into e-waste recycling if there is sufficient focus on training low-income people how to safely handle used electronics. Improving government-sponsored training programs or developing new ones is one step that could help lift people out of poverty while they simultaneously help solve a pressing environmental problem. Prison-to-work training programs also have some potential, but up to this point, the results have been mixed. For programs like UNICOR to be considered a path to green-collar jobs, they need to focus more energy on keeping workers healthy and safe and transitioning them into family-supporting work after they leave. Once people have the skills to refurbish or dismantle old electronics, they can move on to work with recyclers like Norcal that

provide great benefits for their workers or build networks within their communities to help deal with e-waste produced on a local level.

One thing is certain, that e-waste will not go away without continued effort by traditional advocacy groups and greater public participation. Citizens around the world need to push for legislation that will create and support effective solutions to the problem. By pursuing science-based policy, lawmakers can find ways to protect the earth and stimulate the economy at the same time, supporting jobs and providing material inputs back into the economy. A slowing economy is all the more reason to take effective action to lay the groundwork for a sustainable economy that will go strong throughout the 21st century and beyond. We owe it to ourselves and to all those who have suffered from the environmental destruction of the 20th century while receiving few of the benefits.

Appendix

Items Covered by the WEEE Directive, Annex 1A and 1B

Annex IA

Categories of electrical and electronic equipment covered by this Directive

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (with the exception of all implanted and infected products)
9. Monitoring and control instruments
10. Automatic dispensers

Annex IB

List of products which shall be taken into account for the purpose of this Directive and which fall under the categories of Annex IA

1. Large household appliances

Large cooling appliances

Refrigerators

Freezers

Other large appliances used for refrigeration, conservation and storage of food

Washing machines

Clothes dryers

Dish washing machines

Cooking

Electric stoves

Electric hot plates

Microwaves

Other large appliances used for cooking and other processing of food

Electric heating appliances

Electric radiators

Other large appliances for heating rooms, beds, seating furniture

Electric fans

Air conditioner appliances

Other fanning, exhaust ventilation and conditioning equipment

2. Small household appliances

Vacuum cleaners

Carpet sweepers

Other appliances for cleaning

Appliances used for sewing, knitting, weaving and other processing for textiles

Irons and other appliances for ironing, mangling and other care of clothing

Toasters

Fryers

Grinders, coffee machines and equipment for opening or sealing containers or packages

Electric knives

Appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances

Clocks, watches and equipment for the purpose of measuring, indicating or registering time

Scales

3. IT and telecommunications equipment

Centralised data processing:

Mainframes

Minicomputers

Printer units

Personal computing:

Personal computers (CPU, mouse, screen and keyboard included)

Laptop computers (CPU, mouse, screen and keyboard included)

Notebook computers

Notepad computers

Printers

Copying equipment

Electrical and electronic typewriters

Pocket and desk calculators

and other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means

User terminals and systems

Facsimile

Telex

Telephones

Pay telephones

Cordless telephones

Cellular telephones

Answering systems

and other products or equipment of transmitting sound, images or other information by telecommunications

4. Consumer equipment

Radio sets

Television sets

Videocameras

Video recorders

Hi-fi recorders

Audio amplifiers

Musical instruments

And other products or equipment for the purpose of recording or reproducing sound or images, including signals or other technologies for the distribution of sound and image than by telecommunications

5. Lighting equipment

Luminaires for fluorescent lamps with the exception of luminaires in households

Straight fluorescent lamps

Compact fluorescent lamps

High intensity discharge lamps, including pressure sodium lamps and metal halide lamps

Low pressure sodium lamps

Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs

6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)

Drills

Saws

Sewing machines

Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, folding, bending or similar processing of wood, metal and other materials

Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses

Tools for welding, soldering or similar use

Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means

Tools for mowing or other gardening activities

7. Toys, leisure and sports equipment

Electric trains or car racing sets

Hand-held video game consoles

Video games

Computers for biking, diving, running, rowing, etc.

Sports equipment with electric or electronic components

Coin slot machines

8. Medical devices (with the exception of all implanted and infected products)

Radiotherapy equipment

Cardiology

Dialysis

Pulmonary ventilators

Nuclear medicine

Laboratory equipment for in-vitro diagnosis

Analysers

Freezers

Fertilization tests

Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability

9. Monitoring and control instruments

Smoke detector

Heating regulators

Thermostats

Measuring, weighing or adjusting appliances for household or as laboratory equipment

Other monitoring and control instruments used in industrial installations (e.g. in control panels)

10. Automatic dispensers

Automatic dispensers for hot drinks

Automatic dispensers for hot or cold bottles or cans

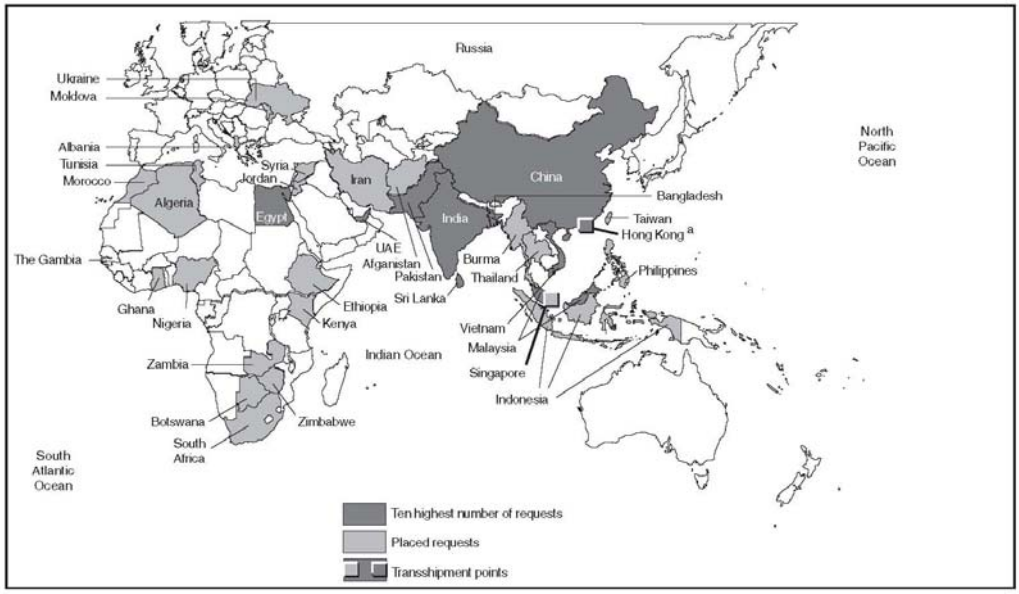
Automatic dispensers for solid products

Automatic dispensers for money

All appliances which deliver automatically all kind of products

GAO Chart: E-Waste Recipient Countries

Figure 1: Developing Countries Requesting CRTs on Two Internet E-commerce Web Sites, February 2008 to May 2008



Source: GAO analysis of two Internet e-commerce sites.

Note: The information presented in figure 1 assumes that buyers do not post fictitious country names. It also assumes no double-counting of requests. Hong Kong and Singapore are the two transshipment points. Hong Kong is a special administrative region of China. Requests were also placed in Aruba, Peru, and Venezuela.

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[1] Stephenson, John B., "Harmful US Exports Flow Virtually Unrestricted Because of Minimal EPA Enforcement and Narrow Regulation," United States Government Accountability Office, Washington, D.C.: United States Government Accountability Office, 12 September 2008 (accessed 31 March 2009).

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